2nd edition

Beluga Whale Population of the Estuary

Background

In 1983, the St. Lawrence Estuary beluga population was considered "endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In 2004, the status of the population was reassessed and changed to threatened. Since 1979, The St. Lawrence belugas have been protected from any hunting and a recovery plan was developed in 1996. In addition to proposing research priorities and actions aimed at reducing threats to the population, the plan also recommends that the population be monitored to determine the long term success of recovery measures.

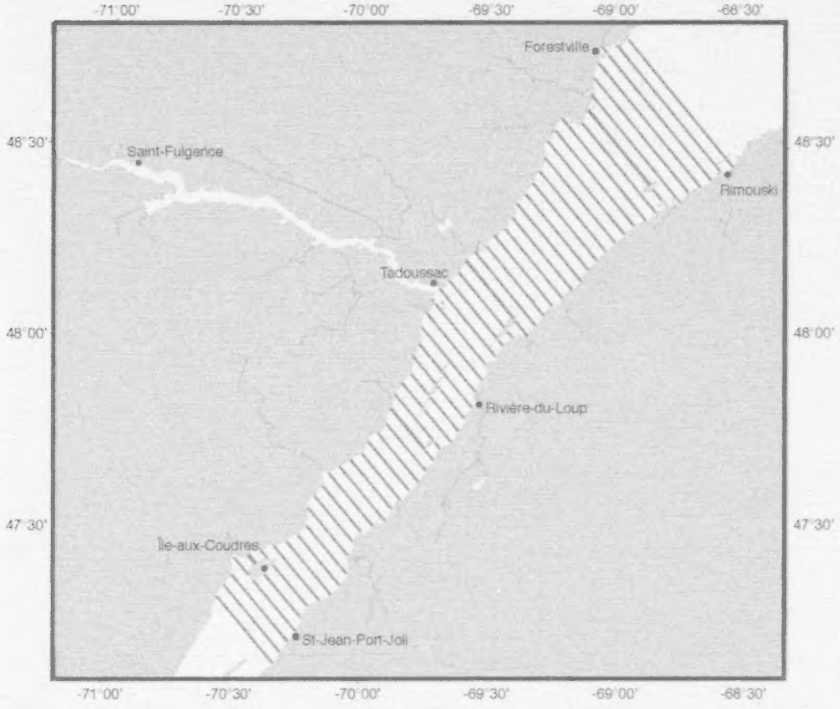
Photo: Véronique Lesage, Fisheries and Oceans Canada

A pod of belugas in the St. Lawrence Estuary. Juveniles are generally grey.

Overview of the Situation

The St. Lawrence Estuary beluga population is estimated at around 1,100 individuals and has been stable for the last 20 years. This estimate, a result of a monitoring programme carried out by Fisheries and Oceans Canada, is based on a population model that includes abundance estimates from a series of seven photographic aerial surveys conducted between 1988 and 2003 (Figure 1), and information from a carcass monitoring program that began in 1982. Abundance indices from the aerial surveys are calculated: 1) by multiplying the number of animals visible on the surface, by a factor of 2 to account for the fact that aerial coverage is only done on half of

Figure 1. Map of the St. Lawrence Estuary showing aircraft flight lines during the photographic aerial survey of the beluga population conducted in 2003



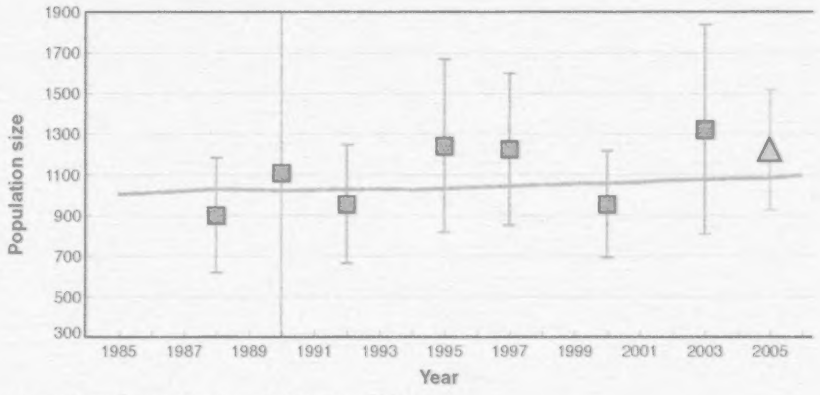
Source: Gosselin *et al.* 2007, CSAS Doc. Res. 2007/025

There have been some 365 documented beluga carcasses since the program's first full year in 1983. The number of reported carcasses has remained relatively stable over the last 25 years with an average of about 15 individuals per year (Figure 3). The actual number of mortalities is likely higher because carcasses drift out into the Gulf, sink or are eaten, and are therefore unaccounted for.

The mean age of stranded beluga carcasses from 1983 to 2005 was 34 years, with the greatest number of carcasses found in the 41-50 age-class (Figure 4). However, some belugas may live over 80 years old. The age of beluga is calculated by counting the number of growth layers in a tooth with one growth layer being associated with one year of life. This method of calculation, based on recent research on the deposition of growth layers, corrects an under-estimation of the age of beluga as previously reported by a factor of two.

the Estuary's surface, 2) by a factor of 2.09 to account for animals that are submerged and therefore invisible during observation. There are significant inconsistencies in terms of abundance estimates, likely because of the difficulty in evaluating the abundance of a small, gregarious population of animals that dive. By using a population model that accounts for abundance estimates, the number of carcasses found, and also the species' possible biological parameter limits (e.g. females give birth every three years), it is possible to eliminate some of these inconsistencies and to provide a more stable abundance estimate (Figure 2).

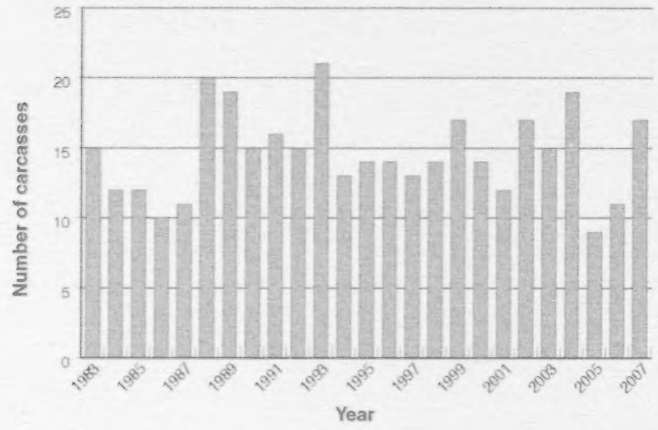
Figure 2. Photographic aerial survey estimates corrected for diving of St. Lawrence Estuary beluga population abundance



Source: Adapted from Hammill *et al.* 2007, CSAS Res. Doc. 2007/066

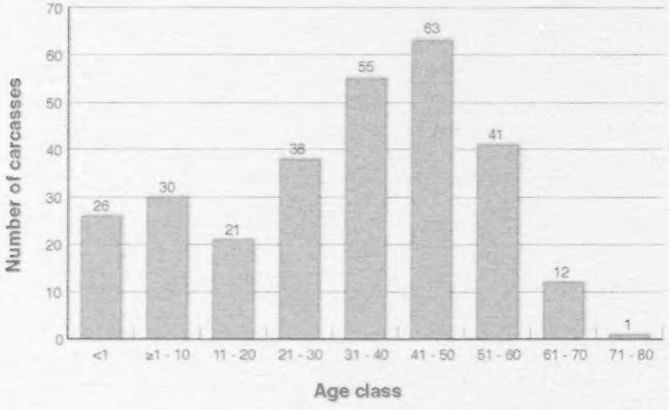
Note: The square points with vertical error bars represent aerial survey estimates. The large triangle represents 2005 visual survey estimates, but these were not used to fit the model.

Figure 3. Number of beluga carcasses documented from 1983 to 2007 in the Estuary and Gulf of St. Lawrence



Source: Adapted from Hammill et al. 2007. CSAS Doc. Res. 2007/026

Figure 4. Age structure of beluga carcasses stranded on the shores of the Estuary and Gulf of St. Lawrence from 1983 to 2005



Source: Fisheries and Oceans Canada, Maurice Lamontagne Institute

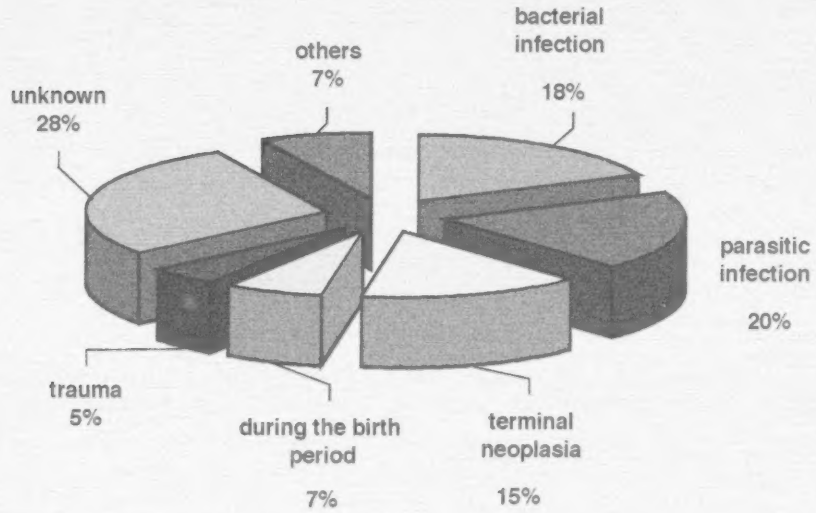
With the collaboration of University of Montreal veterinary pathologists and support from Parks Canada, diagnoses were established concerning the causes of death for 148 individuals. Infectious diseases caused 38% of beluga deaths (age and sex combined), 15% of animals died of terminal neoplasia (cancer) and nearly 30% of unknown causes (Figure 5). Among the stranded calves under one year of age, 58% died during the birth period (Table 1). For juveniles (females between 1-10 years of age and males between 1 and 14 years of age), infectious diseases were responsible for 81% of deaths, 56% of those were caused by verminous pneumonia. Mortality in adults (greater than 10 years old or 14 years old, according to gender) was caused by infectious diseases in 32% of the cases and by terminal neoplasia in 18%. The mean age of beluga dead of terminal neoplasia was 33 years (ranging from 22 to 59 years). Chronic diseases and age-related degenerative diseases, such as cancer, likely play a significant role in this population.

Immune system suppression in beluga may cause some individuals to be more susceptible to infections.

Table 1. Principal causes of death by age group in belugas stranded on the shores of Estuary and Gulf of St. Lawrence (1983 – 2002)(N=148)

Cause of death	Calves N(%)	Juveniles N(%)	Adults N(%)
Bacterial infection	2 (17)	2 (12)	23 (19)
Parasitic infection	2 (17)	11 (69)	16 (13)
Terminal neoplasia			22 (18)
During the birth period	7 (58)		3 (3)
Trauma			7 (6)
Unknown		3 (19)	39 (33)
Other	1 (8)		10 (8)
Total number of carcasses	12	16	120

Figure 5. Principal causes of death of stranded belugas in the Estuary and Gulf of St. Lawrence from 1983 to 2002 (N=148)

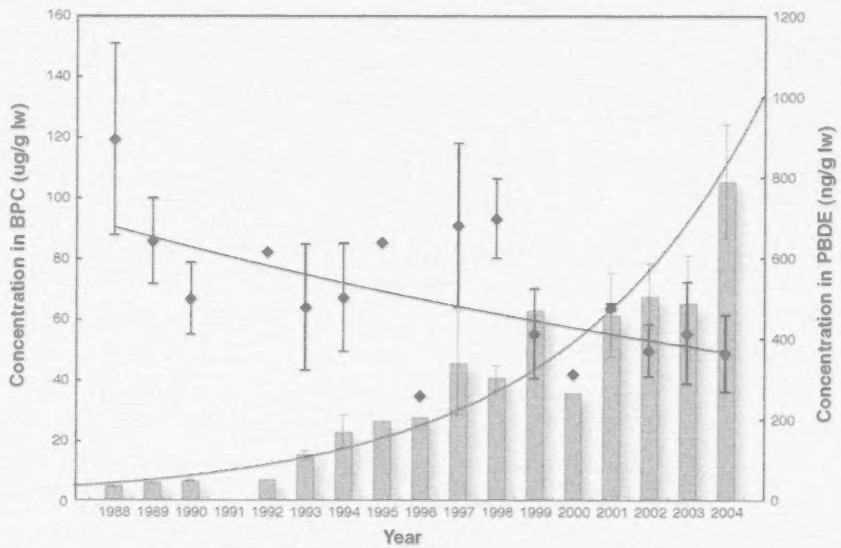


Source: Hammill *et al.* 2007. CSAS Res. Doc. 2007/026.

This includes respiratory diseases such as verminous pneumonia, especially harmful for animals that dive. Nearly 90% of stranded belugas are infected with the parasitic nematode, *Halocercus monoceris*, which can be found in very large numbers (more than 12,500 individuals) in the lungs of some beluga. Another minuscule parasite, *Toxoplasma gondii*, also found in belugas, originates from cats.

Belugas accumulate in their fatty tissue several anthropogenic persistent and toxic organic compounds. It is also recognized that most of these contaminants are immunosuppressive. Chemical analyses of fatty tissue samples from beluga carcasses has shown the temporal trends of contaminants in this population. Levels of polychlorinated biphenyl (PCB), a group of compounds whose use in Canada has been regulated since the late 1970's, were measured in about one hundred adult individuals. Trends in males and females have been dropping by 3-4% per year since the late 1980's (Figure 6). Similar trends have been reported for other compounds, including DDT, while contamination by other compounds such as Mirex, has not decreased during the same period. Even though the downward trend in contaminants may be linked to introduced regulatory measures, other factors such as changes in diet during this period could also explain the drop in levels of contaminants. The slow rate of decrease can also be explained in part by the species' longevity and the inter-generational transfer of these compounds, particularly during the lactation period. Complementary work on emerging chemical compounds has recently revealed that St. Lawrence Estuary belugas are facing a new chemical threat. Levels of polybrominated diphenyl ether (PBDE) double every 3-4 years in this population (Figure 6). PBDE are flame-retardant compounds increasingly used by industry

Figure 6. Temporal trends of PCB (diamonds) and PBDE (bars) accumulations in the fatty tissue of male belugas between 1988 and 2004



Source: Fisheries and Oceans Canada, Maurice Lamontagne Institute

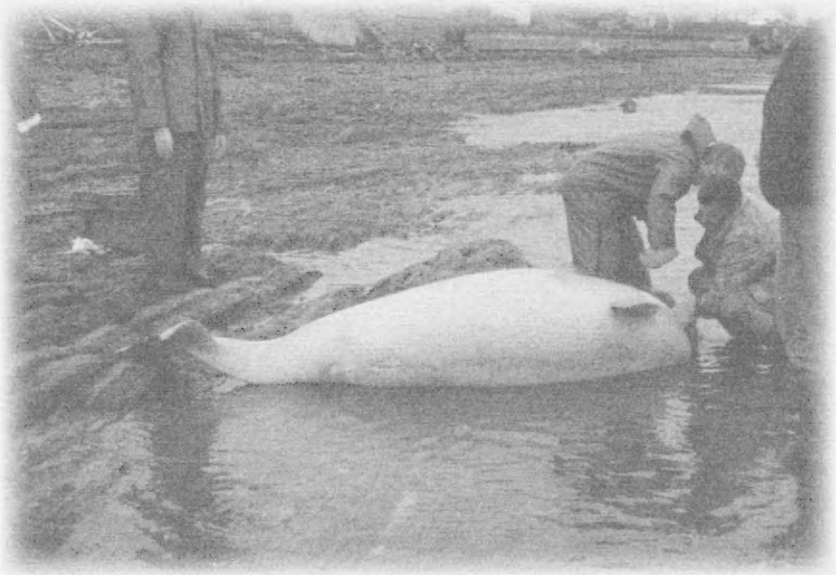


Photo: Lena Measures, Fisheries and Oceans Canada

Biologists examining a beach-cast beluga carcass

throughout North America. However, a regulation to restrict, and even prohibit, their use is currently being developed.

The load of contaminants measured in beluga carcasses continues to be high and the type of contaminants are changing. This suggests that the risk to the beluga population from contaminants with toxic effects has not decreased over the years just as the population has not increased. However, chemical contamination has not been directly linked to pathological effects in belugas. There are many theories attempting to explain why the St. Lawrence beluga population does not show any significant increase or apparent recovery (Table 2).

In 2005, the carcass monitoring program was evaluated during a workshop. It was recommended that the program be maintained, even with its limitations. The program, which is recognized worldwide, contributes to management efforts aimed at helping this population's recovery, monitoring its status and identifying the threats to its recovery. One important recommendation was to integrate the various data (pathologies, contaminants, pathogens, mortalities, surveys, diet, etc.) in order to identify the main causes for the population's lack of recovery.

Outlook

The St. Lawrence Estuary beluga recovery plan must have a long-term perspective. Population monitoring must continue in order to assess periodically its status, which will help evaluate the effectiveness of the management measures put in place. Efforts must be made to reduce inconsistencies in terms of abundance estimates by developing more effective correction factors for diving and for detecting animals on the surface as

Table 2. Theories explaining why the beluga population in the St. Lawrence Estuary shows no apparent signs of recovery

Anthropogenic
- Habitat degradation and changes
- Diseases (microorganisms from wastewater, agricultural and coastal runoff)
- Maritime traffic (noise disturbance, collisions with ships)
- Contaminants (carcinogenic, immunotoxic, neurotoxic, endocrine disruptors)

Ecosystemic
- Changes in prey abundance, diversity and quality
- Competition with other marine mammals or with fisheries for prey
- New diseases or exotic diseases
- Decline in the area's carrying capacity

Genetic
- Inbreeding, low genetic diversity
- Immune incompetence
- Genetic predisposition to infectious and non-infectious diseases
- High frequency of deleterious genes caused by the absence of predators to eliminate weak, sick, or old individuals

Emigration
- Individuals emigrating outside the Estuary and Gulf of St. Lawrence and not contributing to growth of the population

well as spatial analyses for a better understanding of animal distribution. In addition, the Fisheries and Oceans Canada (DFO) beluga carcass monitoring program will contribute by documenting the number and causes of mortalities as well as the presence of certain diseases including new pathogens, emerging contaminants and other threats to this population.

At the same time DFO must continue specific research to understand better the biology and behaviour of the species as well as the impacts of human activity on the St. Lawrence Estuary beluga population. Some new studies are indirectly trying to determine the beluga diet. There is also some work being done on disturbance to the species, particularly from noise in its habitat. Research efforts will also be aimed at identifying sources of contaminants accumulated by belugas, elucidating transfer routes and assessing the effects of chemical contaminant exposure on the St. Lawrence Estuary beluga population. Finally, DFO will continue its work on pathogens, contaminants and pathologies in belugas in order to determine whether a link exists between contaminants and infectious and non-infectious diseases.

All these issues are important within the context of the recovery plan and management measures introduced to protect better the St. Lawrence Estuary beluga.

Photo: Véronique Lesage, Fisheries and Oceans Canada

Photo: Véronique Lesage, Fisheries and Oceans Canada

KEY MEASURES

Aerial photographic surveys, conducted by Fisheries and Oceans Canada, provide abundance indices (in numbers) which help assess the status of the beluga population in the St. Lawrence Estuary. Correction factors are used in order to consider the area not covered by the survey and the animals diving. The model used for monitoring the population integrates these abundance indices and also accounts for various biological parameters (e.g. fertility rate) and the number of carcasses found each year.

The Fisheries and Oceans carcass monitoring program, in place since 1983, provides mortality indices according to age structure. Since 2003, stranded carcasses are reported to the Department by the Group for Research and Education on Marine Mammals and the Quebec Marine Mammal Emergency Response Network. Scientists from the St. Lawrence National Institute of Ecotoxicology take samples from beach strandings, or transport the carcasses to the Faculty of Veterinary Medicine at the University of Montreal where, with the help of Parks Canada, the pathologists may determine the cause of death (e.g. infectious disease, cancer, trauma).

The carcass samples are analysed in order to establish the temporal trend of the beluga population's contamination by persistent and toxic anthropogenic organic compounds (PCB, DDT, Mirex, PBDE). Targeted studies aim to provide information on the species' biology and behaviour, along with the impact of human activities on the beluga population in the St. Lawrence Estuary.

Integrating all the available data and various indicators will provide, on a more long-term basis, a clearer view of the research and actions to prioritize within the recovery framework for the St. Lawrence Estuary beluga.

To Know More

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State of the St. Lawrence Monitoring Program

Under the current Canada-Québec agreement, the St. Lawrence Plan for a Sustainable Development, six government partners—Environment Canada, the Ministère du Développement durable, de l'Environnement et des Parcs du Québec, Fisheries and Oceans Canada, the Ministère des Ressources naturelles et de la Faune du Québec, the Canadian Space Agency, and the Parks Canada Agency—together with Stratégies Saint-Laurent, a non-governmental organization that works actively with riverside communities, are pooling their expertise to provide Canadians with information on the state of the St. Lawrence River at regular intervals.

To obtain the fact sheets and additional information about the State of the St. Lawrence Monitoring Program, please visit our Web site at:

www.planstlaurent.qc.ca

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